Aquatic Chemistry of Mercury

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Mercury (Hg) inputs to the environment have been increased dramatically since industrialization and anthropogenic sources of Hg to the atmosphere now dominate the input. While inorganic Hg is the major source of Hg to most aquatic systems, it is methylmercury (CH_3Hg) that bioconcentrates in aquatic food webs and is the source of health concerns. The dominant source of CH_3Hg is formation within the watershed, and, by current consensus, it is generally accepted that sulfate reducing bacteria (SRB) are the key Hg methylators. However, the relationship between Hg and CH_3Hg concentrations in surface sediments and soils across many ecosystems is weak and thus, its is not just Hg supply, but also the kinetic and thermodynamic factors that alter the supply and bioavailability of Hg to methylators that are important. Clearly, differences in the type and source of Hg to an aquatic system (direct wet or dry deposition, or watershed input) will be important, as will be the chemical interactions that occur within the system. One important competing reaction to methylation is Hg reduction, and subsequent Hg^o evasion from the aquatic system. The chemical controls over this process, and the potential of Hg^o oxidation, will be discussed. Fate and transport within an aquatic system, and burial in sediment, depends on such factors as particle loading, organic matter content (OM), stratification, redox chemistry and other factors. Bioavailability of Hg to SRB's appears to be strongly linked to sulfur chemistry, and this interrelationship, and mechanism of sulfide inhibition of Hg methylation, will be discussed. In addition, the talk will focus on other chemical factors influencing methylation including OM, pH, and the presence/absence of inorganic sulfide phases. Finally, while much of the work to date has focused on understanding Hg transformation processes in terms of a thermodynamic approach, evidence will be presented to demonstrate the importance of kinetics in Hg fate and transport in aquatic systems.